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## THE MARYLAND AGRICULTURAL EXPERIMENT STATION

STATE HORTICULTURAL DEPARTMENT.

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### INSECTS AND DISEASES OF THE TOMATO.

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From the fact that a large amount of land in Maryland is planted in tomatoes each year, and that in all probability a larger acreage will be planted this year, owing to the good prices paid by the canners, it seems advisable at this time to call the attention of the tomato growers to the more common insects and diseases that are likely to affect this crop.

#### FLEA BEETLES.

There are two species of flea beetles which are likely to attack the tomato, namely, the cucumber flea beetle, *Epitrix cucumeris*, and the tobacco flea beetle, *Epitrix parvula*. Although their common names do not signify that they attack the tomato, nevertheless these beetles feed with almost equal readiness on the several vegetables belonging to the solanaceous family of plants.

The adult beetles are very small, dark brown in color, and are at times rather hard to see, as they are provided with well-developed hind legs, which enable them to jump very quickly when disturbed. It is in this stage that they do their principal injury by eating small holes in the little tender leaves of the tomato plant. They appear on the young plants while they are still in the seed-bed, and are still more troublesome on plants when they are first transplanted into the field. The accompanying figure illustrates the tobacco flea beetle in all its stages.

To avoid injury to tomatoes, or similarly-grown plants, spray the plants while in the seed-beds with Bordeaux mixture, to which has been added Paris green, or other arsenites, at the rate of one-quarter pound to the barrel of Bordeaux. If the plants are given a good treatment in the seed-bed shortly before planting in the field, they should be protected from injury for some days, and until they have been able to establish themselves in the soil. Injury in the field may be prevented by occasionally spraying with Bordeaux-Paris green mixture, or by applying Paris green with air-slacked lime, plaster of flour at the rate



of one part of the poison to twenty or thirty parts of the lime, plaster or flour, dusted on the plants from one of the machines known as powder guns, or from a coarse cloth bag or sack.

#### CUT-WORMS.

The tomato is no less subject to the attacks of cut-worms than are many other crops. Grown in seed-beds, as it is, and set out in newly-plowed fields in the summer, the plants are naturally attacked by the worms, which for some days at least have existed in the soil deprived of food. It is a common experience with agriculturists that cut-worms are always more numerous in the fields left in fallow for a period before planted to certain crops. There is a greater variety of vegetation in such fields, and the moths, which lay the eggs that produce the cut-worms, are more apt to be attracted by it.

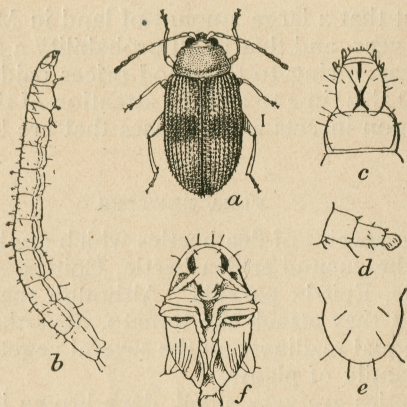


Figure I.—The Tobacco Flea Beetle: a, adult beetle; b, larva, lateral view; f, pupa. a, b, f, fifteen times natural size. (After Chittenden, U. S. Department of Agriculture).

It is a comparatively small matter to rid a field of cut-worms before planting out the tomato, and as a measure of safety this course may be followed to advantage. Often when a field is plowed, and is clear of vegetation and ready for planting, if there are placed here and there over the field small bunches of grass or weeds, which have been sprayed with Paris green and water, it will be found that the cut-worms in the soil, in the absence of other food, will eat this cut, poisoned vegetation, and will be destroyed, so that the tomato plants can be set out without fear of injury. Other means of combating the cut-worms have been discussed by Mr. R. I. Smith, in his circular bulletin entitled "Cut-Worms," which can be had upon application to this Department. Figure IV illustrates one of our common cut-worms, further explanation of which is not necessary.



## THE TOMATO HORN WORM.

Every tomato grower is familiar with the large green worms that appear in his tomato patch when the plants are fairly well-grown. These may be the larvae of either of two species of large sphinx moths. Their caterpillars, from the fact that each bears upon one of the posterior segments of its body a rather stout, curved horn, have become popularly known as horn worms. Tomato growers do not distinguish between the two different kinds of horn worms, and for practical purposes it is not in the least necessary, as both species have been found feeding on the tomato plant. *Protoparce celeus*, which is illustrated with all its stages in Figure II, seems to be more abundant in Maryland.



Figure II.—The Tomato Horn Worm; a, adult moth; b, full-grown larva; c, pupa—natural size. (After Howard, U. S. Department of Agriculture).

The moths make their appearance according to the climate, from May 1st until well on into June, and lay their eggs singly on the underside of leaves. The young caterpillars hatch from these eggs in from four to eight days, according to Professor Alwood's observation of Proto-



parce carolina. There are supposed to be two generations of these insects in Maryland, therefore, two crops of worms.

Both kinds of horn worms are subject to disease and to the attacks of enemies. Caterpillars, which are observed to turn dark in color, are attacked by a bacterial disease, which invariably results in their death. It is also a common occurrence in a tomato field to see one of these worms partly or entirely covered with little white, oval cocoons. Such specimens should not be killed, since the cocoons are those of one of the most important of the parasites of these larvae, which, if allowed to emerge undisturbed, will increase the mortality among the caterpillars.

As to remedial measures against these insects, the old-fashioned method of picking or "worming" will, in ordinary seasons, prove ef-

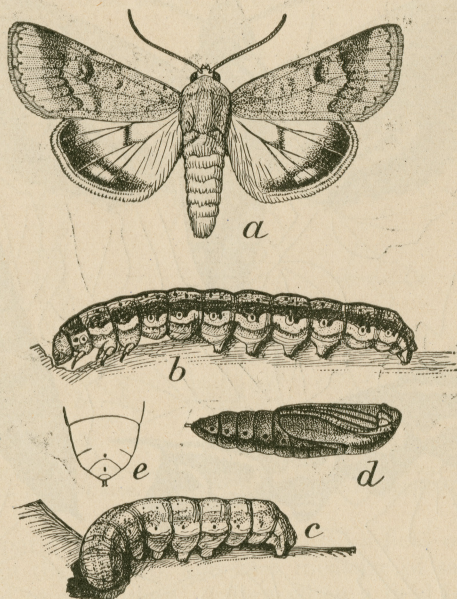


Figure III.—The Tomato Fruit Worm: a, adult moth; b, dark, full-grown larva; c, light-colored full-grown larva; d, pupa—natural size. (After Howard, U. S. Department of Agriculture).

factive in controlling the pests. When the first generation of horn worms appear, an application of Paris green, either dry or in the liquid form, is by far the best remedy when the insects are numerous. I have also seen common crows keep a tomato patch apparently free from these worms.



## THE TOMATO FRUIT WORM.

This species, which is sometimes called the false bud-worm, is the same caterpillar which when occurring upon cotton is called the cotton-boll worm; upon corn, the corn ear worm, and upon tomato, the above. It is the larva of *Heliothis armiger*, a cosmopolitan species of various food habits, and which, as its different names denote, has a destructive propensity for boring into fruit or anything like a pod. Its injury to the tomato is caused by boring into the fruit, and one can often see the worm curled up in its hole in a green or half-ripe tomato.

The insect passes the winter in the pupa condition under the surface of the ground. In spring the moth appears and lays its eggs in the buds of some of its early food plants, the larvae doing serious damage by feeding on the young unveiled leaves. It is probably the second or third generation that is troublesome to tomato growers. The insect, with all its stages, is shown in Figure III.

Arsenical sprays will be efficacious to a certain degree against this insect when it attacks the foliage, but when it attacks the fruit there is practically no means of control. It is a case where an ounce of prevention is more effective than a pound of cure.

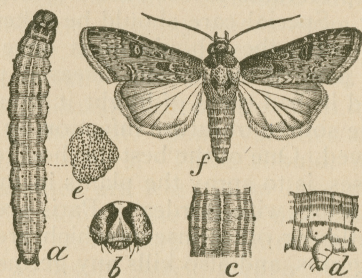


Figure IV.—The Shagreened Cut-Worm: a, larva; f, moth. Natural size. (After Riley).

With this, as with many other insects, there is much to be gained by clean culture in keeping down weeds and other plants on which the insects feed, which may be growing in the vicinity. Late fall plowing is again advantageous by breaking up the little earthen cells in which the pupa are found under the ground, thus exposing them to the action of frost.

There are many other insects which are occasionally injurious to the tomato. Among them may be mentioned the Colorado potato beetle, *Doryphora 10-lineata*, which sometimes attacks the young plants while in the bed, and also when they are set out in the field. The old-fashioned potato beetle, *Epicauta vitata*, and the allied species of blister beetles prove very serious at times by eating the foliage. However, an application of arsenical sprays will hold them in check.



## DAMPING OFF.

Where tomatoes are grown close together in the seed-bed, decay at the surface of the ground (damping off) is liable to occur with close, damp, air, especially during dark, cloudy weather. Much of this can be stopped by thinning the plants, giving light, air and less water. The surface of the ground should be broken up, and the plants never allowed to become slender, and too close together. The dead plants, and soil near them, should be removed to prevent further infection.

## BACTERIAL BLIGHT.

This disease is especially troublesome in the South, and is one of our worst tomato diseases in Maryland. It is indicated by wilting and dark color of stems and leaves. The water-conducting tissue may become filled with the bacterial growth, and cause the plant to wilt or grow very slowly. It is difficult to prevent it, and little can be done for the plants after they are attacked. The same disease occurs on potatoes, egg plant, peppers, and other related plants, possibly on tobacco. The tomato crop should be rotated with other plants than the above, and should not be planted on the same ground again for more than two years. It is preferable to use seed from localities where the blight does not occur. Special care should be taken in the seed-bed, and if diseased plants occur they should be at once removed and destroyed. In the first part of the season diseased plants in the field could be removed, and in bad cases of blight it would be much better to destroy much of the source of future infection by burning the vines after the crop is removed. One of the best methods of controlling this, as well as other diseases, is to spray the plants in the seed-bed two or three times before planting, with Bordeaux-Paris green mixture. This keeps off the flea beetles or other insects which are the means of introducing the blight germs, and also kills any germs which may be on the plants. After the plants are in the field it would be well, also, to spray them with Bordeaux mixture several times before the fruit becomes large.

## MILDEW AND OTHER LEAF DISEASES.

Mildew occurs mostly in greenhouses where tomatoes are grown, but may occasionally become bad in the field. It causes brownish, velvety spots on the lower sides of the leaves, and the leaves may soon drop after becoming diseased. Spraying with Bordeaux mixture is a preventive. Several leaf spots attack the tomato plant, and can usually be kept in control by spraying with Bordeaux mixture with the addition of Paris green for keeping down insects which help to disseminate the leaf diseases, and by other means mentioned under blight.



## FRUIT ROT.

The rot which starts at the blossom end of the tomato is largely caused by bacteria which are introduced by insects. Removing the rotten fruit as fast as it is found, and destroying the insects which attack the fruit, will prevent much of this. Where the plants can be grown stocky or supported in some way to keep the fruit from the ground, much rot may be thus prevented.

## GENERAL TREATMENT.

The best means of controlling tomato diseases is to keep all plants in strong, active, growing condition. Only strong, vigorous, stocky plants should be set out, and as far as possible they should not be checked at any time in their growth. This is one of the principal points in growing perfect tomato plants. If the roots are injured in setting them out, the plants lose vitality, and are much more susceptible to the entrance of blight germs or other diseases, as well as to injury by unfavorable weather.

The plants should be well cultivated and cared for, good land should be used, and rotation (not with potatoes) should be practiced from year to year. Constant cultivation by keeping the moisture in the soil, and keeping weeds down, aids much in keeping the plants in a healthy, vigorous condition. Attention to the plants in the seed-bed is especially necessary. If good plants can be started without contracting disease they will be much more apt to continue in good health during the year. Some varieties are much more susceptible to disease than others. These should, where possible, not be grown. Early varieties are less apt to become diseased, as a rule. Avoid breaking the skin on the plants or fruit during cultivation, or in any other way, as this favors the entrance of disease germs. The plants should be, as before stated, sprayed well in the seed-bed, and when they are set out it is the practice of many successful growers to dip them in Bordeaux mixture before planting. For the preparation of Bordeaux mixture, and its use, see Circular Bulletins 40 and 50.

A few other diseases may attack the tomato, but are, as a rule, not important. Much trouble has been noticed in recent years from failure to set fruit. This is largely due to injury to the pollen by wet weather, or the absence of insects which pollinate the flowers. It is less noticeable on well-drained land or higher ground, where fogs and damp air are not so prevalent.

Some of the resistant varieties that might be mentioned are: For blight, Royal Red, Beauty, Paragon, Dwarf, Champion, Stone, Dwarf Aristocrat. Those more resistant to rot are: Terra Cotta and Lorillard. Others may yet be produced that are more resistant,



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